August 1, 2020

TO: PARTIES INTERESTED IN STEEL CABLE AND FITTING ASSEMBLIES (SCFAs) FOR SEISMIC SWAY BRACING OF NONSTRUCTURAL COMPONENTS

SUBJECT: Proposed Revisions to the Acceptance Criteria for Steel Cable and Fitting Assemblies (SCFAs) for Seismic Sway Bracing of Nonstructural Components – AC413-0820-R1 (MC/VC)

Dear Colleague:

We are seeking your comments on proposed revisions to the subject acceptance criteria, as presented in the enclosed draft. The revisions, which are being posted on the ICC-ES web site for 30 days of public comment, may be summarized as follows:

ICC-ES has an applicant who is interested in an evaluation report to include an evaluation under the 2018 and 2015 IBC. The criteria currently only addresses the 2012 IBC. The following revisions are proposed by ICC-ES staff:

1. Reorganization of referenced standards to address different code editions (2018, 2015 and 2012 IBC) throughout the criteria by adding Table 1.
2. Revision of confirmatory test requirements under the 2018 IBC, for steel cables with a diameter less than 3/8 inch, in accordance with ASCE 19-16.
3. Remove the limitations for other types of fittings under Section 3.4.1, considering the conditions of acceptance of Section 3.4.2.3, Section 3.5.1.3, Section 3.5.2.4.13 and Section 3.5.2.5.10.
4. Minor editorial revisions for consistency among product definitions throughout the criteria.

While the Evaluation Committee will be voting on the revised criteria during the 30-day comment period, we will seriously consider all comments from the public and will pull the criteria back for reconsideration if public comments raise major issues. In that case, we would seek a new committee vote; further revise the draft and post it for a new round of public comments; or put the revised criteria on the agenda for a future Evaluation Committee hearing. Should the committee approve the proposed revisions to the criteria, the ICC-ES staff will not recommend a mandatory compliance date.
However, it should be noted that current applicants for new reports will be required to address any changes that are approved by the committee.

If they are of interest, please review the proposed revisions and send us your comments at the earliest opportunity.

To submit your comments, please use the form on the web site and attach any letters or other materials. If you would like an explanation of the “alternate criteria process,” under which we are soliciting comments, this too is available on the ICC-ES web site.

Please do not try to communicate directly with any Evaluation Committee member about a criteria under consideration, as committee members cannot accept such communications.

Thank you for your interest and your contributions. If you have any questions, please contact me at (800) 423-6587, extension 3288, or Vincent Chui, S.E., Regional Engineering Director, at extension 3244. You may also reach us by e-mail at es@icc-es.org.

Yours very truly,

Manuel Chan, S.E.
Staff Engineer

MC/Is
Encl.

cc: Evaluation Committee
PROPOSED REVISIONS TO ACCEPTANCE CRITERIA FOR
STEEL CABLE AND FITTING ASSEMBLIES (SCFAs) FOR
SEISMIC SWAY BRACING OF NONSTRUCTURAL COMPONENTS

AC413

Proposed August 2020

Previously approved June 2012, June 2009

(Previously editorially revised May 2014)

PREFACE

Evaluation reports issued by ICC Evaluation Service, LLC (ICC-ES), are based upon performance features of the International family of codes. (Some reports may also reference older code families such as the BOCA National Codes, the Standard Codes, and the Uniform Codes.) Section 104.11 of the International Building Code® reads as follows:

The provisions of this code are not intended to prevent the installation of any materials or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

ICC-ES may consider alternate criteria for report approval, provided the report applicant submits data demonstrating that the alternate criteria are at least equivalent to the criteria set forth in this document, and otherwise demonstrate compliance with the performance features of the codes. ICC-ES retains the right to refuse to issue or renew any evaluation report, if the applicable product, material, or method of construction is such that either unusual care with its installation or use must be exercised for satisfactory performance, or if malfunctioning is apt to cause injury or unreasonable damage.

Acceptance criteria are developed for use solely by ICC-ES for purposes of issuing ICC-ES evaluation reports.

ICC EVALUATION SERVICE® and ICC-ES® (and their associated logos) are registered trademarks and service marks of ICC Evaluation Service, LLC, and INTERNATIONAL CODE COUNCIL®, ICC®, INTERNATIONAL BUILDING CODE® and IBC® (and their associated logos) are registered trademarks and service marks of its parent company, International Code Council, Inc.

No portion of this document (AC413) may be copied, reproduced, reprinted, republished, distributed, transmitted, or modified in any form or manner without the express prior written permission of ICC-ES. Any request for such permission should be addressed to ICC-ES at 3060 Saturn Street, Suite 100, Brea, California 92821. Any of the foregoing expressly authorized by ICC-ES must include all the copyright, trademark, service mark and other proprietary rights notices contained herein.

Copyright © 2020 ICC Evaluation Service, LLC. All rights reserved.
PROPOSED REVISIONS TO ACCEPTANCE CRITERIA FOR STEEL CABLE AND FITTING ASSEMBLIES (SCFAs) FOR SEISMIC SWAY BRACING OF NONSTRUCTURAL COMPONENTS (AC413)

1.0 INTRODUCTION

1.1 Purpose: The purpose of this acceptance criteria is to establish requirements for steel cable and fitting assemblies (SCFAs) used for seismic sway bracing of nonstructural components to be recognized in issuance of an ICC Evaluation Service LLC (ICC-ES), evaluation reports for steel cable and fitting assemblies (SCFAs) used for seismic sway bracing of nonstructural components under the 2018 International Building Code® (IBC). The basis of this acceptance criteria and resulting evaluation reports recognition is IBC Section 104.11.

The reason for the development of this criteria is to provide guidelines for the evaluation of cable-fitting assemblies, including both intermediate and end fittings that require testing to determine their structural capacities, since the codes do not provide requirements for testing and determination of structural capacities, reliability and serviceability of these products. This criteria also provides for establishing a documented quality system relevant to the products described above.

1.2 Scope: This acceptance criteria applies to SCFAs that are the main component of tension-only cable seismic sway bracing assemblies (CSSBAs) used to resist only seismic forces and control seismic force-induced sway (displacements) of nonstructural components only. The steel cables shall comply with either ASTM A603 for cables having a diameter equal to or larger than \( \frac{3}{8} \) inch (9.5 mm) or ASTM A1023 (Table 9) for cables having a diameter of less than \( \frac{3}{8} \) inch (9.5 mm), unless otherwise justified with additional testing in accordance with Section 3.1.2.

The following items are beyond the scope of this criteria: (1) attachments described in Section 1.4.1 with the exception of end loops or wrapping of the SCFAs which are required to be qualified according to this criteria; (2) the effects of elevated temperatures on the performance of SCFAs; (3) the effects of fatigue on the performance of SCFAs; (4) use with vibrating equipment unless dynamic loading on cable stresses, fatigue, and deflections of the SCFAs is considered by the registered design professional for the specific applications; (5) protection against sharp resonant motions of nonstructural components, or shock loading; (6) outdoor applications and necessary corrosion protection; (7) special certification requirements for Designated Seismic Systems required by Sections 13.2.2, 13.2.5 and 13.2.6 of ASCE/SEI 7; (8) use as rigid seismic sway braccings resisting tension and compression forces; (9) replaceability requirement prescribed in Section 3.1.2 of ASCE/SEI 19-12; (10) post-construction considerations and inspection requirements prescribed in Section 9.0 of ASCE/SEI 19-12; and (11) pipe clamps, grooved couplings, or other similar hanger devices that are installed for the purpose of attaching SCFAs to sprinkler pipes.

1.3 Codes and Referenced Standards: Where standards are referenced in this criteria, these standards must be applied consistently with the code upon which compliance is based. See Table 1.


1.3.2 ASCE/SEI 7-10, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers.

1.3.3 ASCE/SEI 19-10, Structural Applications of Steel Cables for Buildings, American Society of Civil Engineers.


1.3.5 ASTM A603-08 (9), Standard Specification for Zinc-Coated Steel Structural Wire Rope, ASTM International.


1.4 Definitions in the IBC, ASCE/SEI 7 and ASCE/SEI 19 apply to this criteria. In addition, the following definitions apply:

1.4.1 Attachments: Attachments as defined in Section 11.2 of ASCE/SEI 7, amended as follows: Attachments of CSSBAs consist of end loops or wrapping of the cable of the SCFAs qualified according to this criteria, and anchor bolts and mechanical fasteners used to connect fittings to the nonstructural components or their supports.

1.4.2 Confirmatory Test: Testing of materials to establish conformance with the requirements set forth in the codes and referenced standards.

1.4.3 Fitting: A structural steel device, bracket, or proprietary part intentionally configured and designed for SCFAs. In this criteria, fittings are considered part of the “supports” and are distinct from the “attachments.” For purposes of this criteria, both “end fittings” and “intermediate fittings” described in ASCE/SEI 19-12 Sections 3.3.2 and 8.3, respectively, are considered as end fittings.

1.4.4 Nonstructural Component: A part or element of an architectural, electrical or mechanical system that is permanently attached to the supporting structures. The design of the component’s supports and attachments is required to comply with Chapter 13 of ASCE/SEI 7.

1.4.5 Qualification Test: Testing of components and assemblies of SCFAs to establish the structural performance of specific SCFAs for recognition inclusion in an ICC-ES evaluation report.
1.4.6 Seismic Sway Bracings: The supports defined in this criteria which transmit the seismic loads induced by the nonstructural components to the supporting structures.

1.4.7 Steel Cable and Fitting Assembly (SCFA): A cable seismic sway brace assembly, consisting of steel cable(s) and their corresponding fittings that are considered part of the supports, as defined in Section 11.2 of ASCE/SEI 7 and Section 1.4.10 of this criteria, which resists tension forces only.

1.4.8 Cable Seismic Sway Bracing Assembly (CSSBA): A cable seismic sway bracing assembly (SCFA) and its end attachments, as defined in Sections 1.4.7 and 1.4.1 of this criteria, respectively.

1.4.9 Specified Nominal Cable Strength: The nominal cable strength, as defined in Section 1.2 of ASCE/SEI 19 and the applicable referenced standard, such as ASTM A1023. Also referred as “minimum breaking strength” or “minimum breaking force”.

1.4.10 Supports: As defined in Section 11.2 of ASCE/SEI 7, with following amendment: In this criteria, supports include steel cable assemblies (steel cables and the corresponding fittings) that act as seismic sway bracings.

2.0 BASIC INFORMATION

2.1 General: The following information shall be submitted:

2.1.1 Product Description: A detailed description of the SCFAs, including information concerning material specifications, configurations, dimensions, the manufacturing process, and restrictions or limitations on use. Information shall be provided on, but not be limited to, the following items:

2.1.1.1 Steel Cables (Wire Strands, Steel Wires and Wire Ropes, as Applicable): Referenced specifications, classifications, constructions, grades, sizes, wire finishes, core types, directions and types of rope lays, specified nominal cable strengths, minimum specified prestretching forces, and minimum specified values of modulus of elasticity.

2.1.1.2 Fittings: Referenced specifications, grades and designations of steel, shapes and dimensions, and tolerances: sectional properties when applicable, mechanical properties, including yield and tensile strength, area reduction and elongation; manufacturing process or source; and shop and field installation requirements.

2.1.1.3 Installation Applications: Detailed drawings of unique applications of SCFAs for each end use condition, where a specific combination of cable, fitting(s) and end attachment(s) constitutes a unique installation application.

2.1.2 Packaging and Identification: Product identification shall comply with the product identification provisions of the ICC-ES Rules of Procedure for Evaluation Reports. A description of the method of packaging and field identification of all components of the SCFAs shall be submitted. Field identification provisions shall include the name of the report holder and permanent color cable coating to identify cable strength and the ICC-ES evaluation report number.

2.1.3 Installation Instructions: Instructions shall include the following items:

2.1.3.1 A description of how SCFAs are installed at the project site, including product handling and storage; procedures for field fabrication of crimped connectors of looped or wrapped steel cable end attachments; procedures for performance (strength and stiffness) verification; and cutting or other field modifications to the shipped assembly components.

2.1.3.2 Procedures for quality control (special inspection) at project sites during installation and fabrication of crimped connectors of looped or wrapped end attachments.

2.2 Testing Laboratories: Testing laboratories shall comply with Section 2.0 of the ICC-ES Acceptance Criteria for Test Reports (AC85) and Section 4.2 of the ICC-ES Rules of Procedure for Evaluation Reports.

2.3 Test Reports: Test reports shall comply with AC85. Detailed descriptions of the test plan, including test procedures and conditions of acceptance, shall be provided in the test report.

2.4 Product Sampling: Sampling of the SCFAs for tests under this criteria shall comply with Section 3.1 of AC85. The fabrication of the test assemblies described in Section 3.4 shall be witnessed by or verified by the testing laboratory.

3.0 TEST AND PERFORMANCE REQUIREMENTS

3.1 General: This Section (3.0) prescribes test and performance requirements for ropes (steel cables), wires, fittings and the SCFAs, which are described in Sections 3.2, 3.3, 3.4 and 3.5, respectively.

3.1.1 Test Specimens: For rope steel cable testing prescribed in Section 3.2, test specimens for each type of steel cable rope, conforming to ASTM A603 or A1023, as applicable, shall be from the same heat. For fitting testing prescribed in Section 3.4, test specimens for each fitting type shall be from the same heat. For SCFA testing prescribed in Section 3.5, the rope steel cables and fittings used to manufacture the test specimens shall be from the same heat as those of testing per Sections 3.2 and 3.4, respectively.

3.1.2 Additional Testing Requirements for Nonconforming Steel Cables: When steel cables do not comply with either ASTM A603 or ASTM A1023, additional testing shall be conducted as required by the cable material standards, as applicable. The report applicant, in consultation with ICC-ES, shall develop a test plan which shall be submitted to ICC-ES for review prior to commencement of testing. For steel cables with a diameter less than 3/8 inch (9.5 mm) evaluated under the 2018 IBC, only confirmatory testing of the steel cable’s outside diameter and minimum breaking force as outlined on Sections 3.2.1 and 3.2.2 shall be completed. Steel wire confirmatory testing is not required.

3.2 Wire Rope Steel Cable (Confirmatory Tests):

3.2.1 Diameter Test (for Steel Cables Conforming to ASTM A1023 only): The purpose of this test is to verify that the steel cable wire rope having a diameter of less than 3/8 inch (9.5 mm) is constructed within the permissible tolerances prescribed in ASTM A1023.
3.2.1.1 **Test Procedure:** The test shall be conducted in accordance with Section 8.6.1 of ASTM A1023 as follows: Measurements for diameters shall be taken on a straight portion of the rope, steel cable without tension, at two positions spaced at least 3 feet (or 1 meter) apart, and at each position two diameters (Figure 8) at right angles shall be measured. Sample size shall be a minimum of three specimens for each rope, steel cable size of each rope, steel cable construction.

3.2.1.2 **Conditions of Acceptance:** Each test specimen shall satisfy the following requirements: The average of the four measurements for each specimen tested shall be within the tolerances given in Tables 5 and 6 (Tables 3 and 4 under the 2018 IBC) of ASTM A1023 and the permissible differences between any two individual diameter measurements shall be within the tolerances given in Tables 7 and 8 (Tables 5 and 6 under the 2018 IBC).

3.2.2 **Tension Test:** The purpose of this test is to verify the mechanical properties including specified nominal cable strength, modulus of elasticity, elongation, stiffness and load-displacement characteristics of wire rope, steel cables; and to demonstrate that wire, rope, steel cables comply with the requirements set forth in ASCE/SEI 19, ASCE/SEI 7 and applicable referenced standards. The test shall be conducted in accordance with Section 3.2.2.1. The conditions of acceptance are specified in Section 3.2.2.2.

3.2.2.1 **Test Procedure:** The test shall be conducted in accordance with ASTM A931. Test provisions for modulus of elasticity, specified in ASTM A931, shall be modified as necessary to comply with ASCE/SEI 19 and to account for prestretching forces specified by the manufacturer. Sample size shall be a minimum of three specimens for each steel cable, rope size of each steel cable, rope construction.

3.2.2.2 **Conditions of Acceptance:** Each test specimen shall satisfy the following requirements: The actual (measured) breaking force obtained shall be equal to or greater than the specified nominal cable strength required by the applicable referenced standard, such as ASTM A603 or A1023; the measured modulus of elasticity shall meet the minimum specified modulus of elasticity required by Sections 4.2 and 7.3 (and Section E7.3.1 under the 2018 IBC) of ASCE/SEI 19 and the applicable reference standard, such as ASTM A1023 or A603; no rope, steel cable slippage shall occur in the end anchorages to the test apparatus; and no wire break shall occur within one steel cable, rope diameter of the anchorages to the test apparatus. If any specimen does not comply with above conditions of acceptance, the steel cable, rope shall be considered unqualified.

3.3 **Steel Wire (Confirmatory Tests):**

3.3.1 **Size of Test Samples:**

3.3.1.1 **For Cables Having a Diameter of Less Than 3/8" Inch (9.5 mm) (Conforming to ASTM A1023):** The sample size for tension tests, wrap tests, metallic coating tests, wire diameter tests, and torsion tests, described in Section 3.3, shall be as prescribed by Section 8.7.2 and defined in Sections 3.4 (strand), 3.6.2.2 (load-bearing wires [main wires]), and 3.6.3 (layer of wires) of ASTM A1023. For 7x7 and 7x19 construction in Table 9 of ASTM A1023 as referenced by ASCE/SEI 19, there shall be six samples tested for each wire size of each size of 7x7 cable construction and 18 samples tested for each wire size of each size of 7x19 cable construction. The center wires have been excluded from the sample as prescribed by Section 8.7.3.3 of ASTM A1023.

3.3.1.2 **For Cables Having a Diameter of 3/8" Inch (9.5 mm) or Larger (Conforming to ASTM A603):** The sample size for tension (including elongation) tests, wrap tests (including ductility tests and adherence of coating tests), and metallic coating tests, described in Section 3.3, shall be a minimum of the following for each wire size of each cable construction but no less than three samples of each wire size of each cable construction: The sample size shall be a minimum of all the main wires from the equivalent of one complete strand of each layer, strand diameter and strand construction, including the steel cable, rope core. For purposes of this criteria, the main wires are the load-bearing wires, a layer of wires is an assembly of wires having one pitch diameter where the first layer of wires is that which is laid over the strand center, and a strand is an assembly of wires laid helically in one or more layers around a center and where multiple wires are used around in a strand center they are counted as one wire.

3.3.2 **Wires in Cables with Less Than 3/8" Inch (9.5 mm) Diameter (Conforming to ASTM A1023 Only):** For cables having a diameter of less than 3/8" inch (9.5 mm), as permitted by Section 8.7 of ASTM A1023, test wires for wire testing under Section 3.3 may be taken before or after fabrication of the steel cable, rope, except that after fabrication wire testing shall not be allowed for compacted strand wires, steel cables or swaged (compacted) steel cables, rope. For after fabrication wire testing, the level of acceptance may be modified in accordance with Section 8.7.4 of ASTM A1023.

3.3.3 **Tension Test:** The purpose of this test is to verify the tensile properties of steel wires used to manufacture steel cables, including tensile strength, stress at 0.7 percent extension under load, and total elongation (including construction extension, elastic extension and the permanent extension) for cables having a diameter of 3/8" inch (9.5 mm) and larger, or the tensile strength for cables having a diameter of less than 3/8" inch (9.5 mm) and to demonstrate that the wires comply with the requirements set forth in ASCE/SEI 19 and applicable referenced standards. The test shall be conducted in accordance with Section 3.3.1.1. The conditions of acceptance are specified in Section 3.3.1.2.

3.3.3.1 **Test Procedure:** The test shall be conducted in accordance with Sections 6.1 through 6.4 of ASTM A603, or Section 8.7 of ASTM A1023 and Section 8 of ASTM A1007 for wires in cables having a diameter less than 3/8" inch (9.5 mm).

3.3.3.2 **Conditions of Acceptance:** Each test specimen shall conform to the mechanical properties (tensile stress, stress at 0.7 percent extension under load and total elongation) specified in Table 6 of ASTM A603 and Sections 6.1, 6.2, 6.3, 6.4 and 11 of ASTM A603, or the tensile strengths (minimum breaking forces) specified in Section 8 of ASTM A1007 for wires in cables having a diameter of less than 3/8" inch (9.5 mm). If any of the test specimens does not comply with the conditions of acceptance set forth in this section, the steel wire shall be
considered unqualified, unless otherwise permitted by Section 3.3.2 for the level of acceptance.

3.3.4 Wrap Tests: The wrap tests shall be required for all metallic coated steel wires. The purpose of these tests is to verify that the metallic coated steel wires conform to steel ductility and coating adherence requirements set forth in Sections 4.0 and 6.0 of ASCE/SEI 19 and applicable referenced standards. The tests shall be conducted in accordance with Section 3.3.4.1. The conditions of acceptance are specified in Section 3.3.4.2.

3.3.4.1 Test Procedures: The test for steel ductility shall be conducted in accordance with Section 6.5 of ASTM A603 or Section 10.1 of ASTM A1007 for wires in cables having a diameter less than \( \frac{3}{8} \) inch (9.5 mm). Testing for adherence of coating shall be conducted in accordance with Section 6.7 of ASTM A603, or Section 10.2 of ASTM A1007 for wires in cables having a diameter less than \( \frac{3}{8} \) inch (9.5 mm).

3.3.4.2 Conditions of Acceptance: Each test specimen for steel ductility testing shall satisfy the requirements set forth in Section 6.5 of ASTM A603, or Section 10.1 of ASTM A1007 for wires in cables less than \( \frac{3}{8} \) inch (9.5 mm) in diameter. Each test specimen for the adherence of coating test shall satisfy the requirements set forth in Section 6.7 of ASTM A603, or Section 10.2 of ASTM A1007 for wires in cables less than \( \frac{3}{8} \) inch (9.5 mm) in diameter. If any of the metallic coated steel wire test specimens do not comply with the conditions set forth in this section, the metallic coated steel wire shall be considered unqualified, unless otherwise permitted by Section 3.3.2 for the level of acceptance.

3.3.5 Metallic Coating Test: The metallic coating test shall be required for all metallic coated steel wires. The purpose of this test is to demonstrate that the metallic coated steel wires comply with the protective coating requirements set forth in Sections 4.0 and 6.0 of ASCE/SEI 19 and applicable referenced standards. The test shall be conducted in accordance with Section 3.3.5.1. The conditions of acceptance are specified in Section 3.3.5.2.

3.3.5.1 Test Procedure: The test shall be conducted in accordance with Sections 6.6 and 7 of ASTM A603, or Section 11 of ASTM A1007 for wires in cables less than \( \frac{3}{8} \) inch in (9.5 mm) diameter.

3.3.5.2 Conditions of Acceptance: Each test specimen shall satisfy the requirements set forth in Sections 6.6 and 6.8 and Table 7 of ASTM A603, or Section 6.4 (Table 3 or 4) of ASTM A1023 for wires in cables less than \( \frac{3}{8} \) inch (9.5 mm) in diameter. If any of the metallic coated steel wire test specimens do not comply with the conditions set forth in this section, the metallic coated steel wire shall be considered unqualified, unless otherwise permitted by Section 3.3.2 for the level of acceptance.

3.3.6 Wire Diameter (for Cables Conforming to ASTM A1023 Only): The steel wire diameter shall be measured for wires in cables less than \( \frac{3}{8} \) inch (9.5 mm) in diameter in accordance with Section 8.6 of ASTM A1023 and Section 7.1 of ASTM A1007. Each test specimen shall satisfy the diameter measurement and tolerance requirements set forth in Section 7.2 of ASTM A1007, unless otherwise permitted by Section 3.3.2 for the level of acceptance.

3.3.7 Torsion Test (for Cables Conforming to ASTM A1023 Only): The torsion test shall be required for steel wires in cables less than \( \frac{3}{8} \) inch (9.5 mm) in diameter complying with ASTM A1007. Torsional tests shall be conducted in accordance with Section 9 of ASTM A1007. Each test specimen shall satisfy the requirements set forth in Table 3 and Section 9.2 of ASTM A1007, unless otherwise permitted by Section 3.3.2 for the level of acceptance.

3.4 Fittings:

3.4.1 Acceptable End Fittings: Section 5 of ASCE/SEI 19 limits the use of end fittings to Zinc-Poured and Mischmetal-Poured Fittings, Resin-Poured Fittings, and Swaged Fittings and Mechanical Loop Splice with Sleeve and Thimble. Other types of fittings, such as Clip and Wedge Type fittings, shall not be permitted.

3.4.2 Fitting Confirmatory Test:

3.4.2.1 Strength Test: The purpose of this test is to verify the mechanical properties of the fittings sought for recognition in an ICC-ES evaluation report, such as yield strength, ultimate tensile strength, elongation, area reduction, and modulus of elasticity; and to demonstrate that the fittings comply with requirements set forth in ASCE/SEI 19, and applicable referenced standards. The test shall be conducted in accordance with Section 3.4.2.2. The conditions of acceptance are specified in Section 3.4.2.3.

3.4.2.2 Test Procedure: The proposed test procedure shall be based upon a nationally recognized standard, such as ASTM E8, and with necessary modification, so as to simulate the intended fitting applications and to comply with ASCE/SEI 19. Sample size shall be a minimum of five specimens for each fitting application, with consideration of factors that influence performance. Fitting application factors that influence the load-carrying capacity include the type or kind of fitting; mechanical properties; sizes/dimensions and orientation of the fitting with respect to cable assembly; characteristics of interaction among fittings, steel cables and attachments; and the method of fitting installation. Each combination of these factors must be tested separately, unless the critical combination in a proposed grouping can be established by tests. The report applicant shall submit the proposed test procedure (including modifications for the intended applications) to the ICC-ES for approval prior to the tests being conducted.

3.4.2.3 Conditions of Acceptance: Each tested fitting specimen shall develop an ultimate tensile strength of at least 100 percent of the specified nominal cable tensile strength. If any of the specimens does not comply with above condition of acceptance, the fitting shall be considered unqualified.

3.5 SCFA (Qualification Test):

3.5.1 Static Tension Testing:

3.5.1.1 Purpose: The purpose of this test is to verify the structural performance (strength and stiffness) of the steel cable and factory-attached fitting assembly (SCFA); and to demonstrate that the SCFA complies with requirements set forth in ASCE/SEI 19, including Sections 3, 4, 5, 7 and 8 (and Appendix E under the 2018 IBC), and applicable referenced standards. The test shall be
conducted in accordance with Section 3.5.1.2. The conditions of acceptance are specified in Section 3.5.1.3.

3.5.1.2 Test Procedure: The proposed test procedure shall be based upon a nationally recognized standard, such as ASTM E8, and with necessary modifications, so as to simulate the intended applications of each SCFA and to comply with ASCE/SEI 19. There shall be a minimum of three specimens for each SCFA application, with consideration of factors that influence performance, including different combinations of fittings, cables and end loops or wrapping. Additional performance factors include extreme values of cable sizes, orientation of the SCFAs with respect to the supporting structure and the braced nonstructural component, and characteristics of interaction among fittings and steel cables and end loops or wrapping. To simulate the typical field applications, the angle of the connection of the test specimen (SCFAs) shall be varied at 30, 45, 60 and 90 degrees from the vertical. The report applicant shall submit a test proposal to ICC-ES for approval prior to testing. The proposal shall detail the test procedures, test specimen configurations, and sample size of the SCFA test specimens.

3.5.1.3 Conditions of Acceptance: Each test specimen shall satisfy the following requirements: The actual (measured) breaking force obtained shall be equal to or greater than the specified minimum breaking force (specified nominal strength) of the cable; break shall only occur within the cable; break shall not occur in the intermediate or end fittings, nor in the cable end loops or wrapping. If any of the specimens does not comply with the above conditions of acceptance, the corresponding test configuration of the SCFA shall be considered unqualified.

3.5.2 Cyclic Tension Testing (Optional):

3.5.2.1 Purpose: The purpose of this test is to determine the maximum (ultimate) load (capacity) and the maximum deformation limit under allowable load of a SCFA when it is subjected to cyclic tension loading.

3.5.2.2 Test Plan: The report applicant shall submit a test plan proposal to ICC-ES for review before commencing testing. The test plan proposal shall detail the test procedures, test specimen, configurations, and sample size of the SCFA test specimens accounting for the product ranges to be included recognized in the evaluation report.

3.5.2.3 Specimens: The test shall be conducted on at least three replicate specimens for each SCFA configuration, with consideration of factors that influence the structural performance, including different combinations of fittings (types and mechanical properties), cables (types, diameters, and mechanical properties), end loops or wrapping, installation angles from vertical, and sprinkler pipes (materials, strength/grade, and dimensions), as applicable, and means of attachment at ends of SCFAs.

For SCFAs used to brace sprinkler pipes, the SCFA test specimens shall be at least 18 inches (457 mm) in length, and shall be connected at one end to a 6-inch-long (150 mm) piece of fire sprinkler pipe, and shall be connected at the other end to a fixture. The connections between SCFAs and sprinkler pipes shall use NFPFA 13 recognized devices, as applicable, and shall simulate the end use for which recognition is sought. Inclusion in an evaluation report. The connections between the SCFAs and the fixture shall simulate the field installations, including using code-prescribed mechanical fasteners, and shall be able to be adjusted from 0° to 90° from vertical so as to simulate the installation angles of specimens from vertical that range from 30° to 90°.

3.5.2.4 Cyclic Testing (to Determine the Load Capacity):

3.5.2.4.1 The expected failure load is determined using test data from static tension testing required per Section 3.5.1.

3.5.2.4.2 The SCFA specimens are attached to the test fixture according to the manufacturer’s installation instructions.

3.5.2.4.3 The system (test specimen) is loaded in tension to 5% ± 1% of the rated breaking strength of the cable.

3.5.2.4.4 The specimen dimensions, such as length, width, and thickness/diameter, are measured and recorded.

3.5.2.4.5 The cable is marked so that any slippage can be recorded.

3.5.2.4.6 The system load is increased to 10 percent of the rated breaking strength of the cable, and any distortions, slippage, or deformations of the system components are recorded.

3.5.2.4.7 The system is unloaded to 5% ± 1% (the initial preload) and any distortions, slippage, or deformations of the system components are recorded.

3.5.2.4.8 Repeat procedures described in Sections 3.5.2.4.6 and 3.5.2.4.7 for loads of 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100% of the rated breaking strength of the cable.

3.5.2.4.9 If the specimen did not fail when subjected to procedures described in Section 3.5.2.4.8, continue loading the specimen in 10% increments until it fails.

3.5.2.4.10 Record the load and mode of failure.

3.5.2.4.11 Repeat procedures described in Sections 3.5.2.4.1 through 3.5.2.4.10 using new specimens for the other angles that require testing.

3.5.2.4.12 The average of the three replicate tests shall be used to determine the maximum load of each SCFA configuration, provided the coefficient of variation (COV) of the test results does not exceed 0.15. If the COV exceeds 0.15, additional tests are required until the COV is not greater than 0.15.

3.5.2.4.13 The rated maximum (ultimate) load (capacity) of the SCFA shall be the smaller of the cable nominal breaking strength (qualified through static testing under Section 3.5.1) and the cyclic tested maximum load under this section (Section 3.5.2.4). The allowable load of the SCFA shall be the rated maximum load divided by a safety factor of 2.2, in accordance with Section 3.0 of ASCE/SEI 19.

3.5.2.5 Cyclic Testing (to Determine the Displacement Limit under Allowable Load):

3.5.2.5.1 The SCFA specimen is attached to the test fixture in accordance with the manufacturer’s installation instructions.
3.5.2.5.2 The system (test specimen) is loaded in tension to 5% ± 1% of the rated breaking strength of the cable.

3.5.2.5.3 The specimen dimensions, such as length, width, and thickness/diameter, are measured and recorded.

3.5.2.5.4 The cable is marked so that any slippage can be recorded.

3.5.2.5.5 The system is loaded to the allowable load determined per Section 3.5.2.4 and unloaded to 1 percent of the allowable load, with a load frequency of 0.1 Hz.

3.5.2.5.6 The load/unload cycle prescribed in Section 3.5.2.5.5 is repeated for a total of 15 cycles.

3.5.2.5.7 The total displacement/ deformation of the SCFA at the allowable load in the fifteenth cycle is recorded, along with any distortions, slippage, or deformations of the system components, after the fifteenth cycle is completed.

3.5.2.5.8 Procedures described in Sections 3.5.2.5.1 through 3.5.2.5.7 are repeated on three replicate specimens for each SCFA configuration, by using new specimen for each test.

3.5.2.5.9 Procedures described in Sections 3.5.2.5.1 through 3.5.2.5.8 are repeated for other angles that require testing.

3.5.2.5.10 Conditions of Acceptance: In order to be qualified under this criteria (Section 3.5.2.5), test specimens shall not break, and the measured specimen deformation shall not exceed 2 inches (50 mm) in the horizontal plane. If any of the specimens does not comply with the above conditions of acceptance, the corresponding test configuration of the SCFA shall be considered unqualified.

4.0 STRUCTURAL DESIGN

4.1 Design Strength: The design strength of an SCFA, qualified in accordance with Section 3.0 of this criteria, is equal to the design strength of the steel cable, defined in Section 3.2 of ASCE/SEI 19, which is based on the specified nominal cable strength, defined in Section 1.4.9 of this criteria, or equal to the rated maximum load prescribed in Section 3.5.2.4, if cyclic tension testing prescribed in Section 3.5.2 is conducted. The horizontal component of the design strength of an SCFA is equal to the design strength of the SCFA multiplied by the sine of the angle between the cable longitudinal axis and the vertical direction. The structural design of SCFAs is based upon combined Allowable Stress Design (ASD) and Strength Design —(LRFD), identified in Section 3.0 of ASCE/SEI 19 and Sections 20.2 and 1602.1 of the IBC. The ASD load combinations prescribed in ASCE/SEI 19 Section 3.0 are equivalent to those described in IBC Section 1605.3.1. In accordance with Section 3.3.1 of ASCE/SEI 19, the design strength (which is LRFD approach, defined per IBC Section 20.2) of an SCFA shall be equal to or greater than the load effects prescribed by the ASD load combinations in Sections 3.2.2 and 3.2.3 of ASCE/SEI 19, as applicable, and multiplied by a factor of 2.2. This approach corresponds to an ASD design method with a safety factor of 2.2. Provisions described in Section 2208.2 of 2015 and 2012 IBC are modified in this criteria. Item 2 of Section 2208.2 of the IBC shall not be applicable. Item 1 of Section 2208.2 of the IBC is modified to read as follows: A load factor of 1.1 shall be applied to the prestress force included in $T_s$, $T_{cb}$, $T_{cc}$, $T_r$, and $T_c$ as defined in Section 3.2 of ASCE/SEI 19-10. The design and evaluation of supports and attachments for nonstructural components shall comply with Chapter 13 of ASCE 7 and shall consider their flexibility as well as their strength. In accordance with the provisions of Section 13.6.8.2 (13.6.7.2 under the 2018 IBC) of ASCE/SEI 7, fire protection sprinkler piping, pipe hangers, and bracing designed and installed in accordance with NFPA 13 shall be deemed to meet the force and displacement requirements of Chapter 13 of ASCE/SEI 7. SCFAs and CSSBAs qualified under this criteria are used to satisfy the bracing requirements (for force and displacement) specified in NFPA 13.

4.2 Stiffness: The stiffness of each SCFA shall be determined based upon test data described in applicable requirements of Sections 3.0, 4.2.1 and 4.2.2 and shall be included in the evaluation report as required by ASCE/SEI 7, including Section 13.6.2 (13.3.3 under the 2018 IBC) for determining the component fundamental period and Section 13.2.4 for flexibility of the CSSBAs.

4.2.1 Tension Tests of Cables: The tension tests on cables and test procedures identified in Section 3.2.2 shall be used to test and report on the permanent and elastic elongation/deformation under incremental loads of 20 percent, 40 percent, 60 percent, 80 percent and 100 percent of the specified minimum (nominal) breaking strength of the cables.

4.2.2 Tension Tests of Fittings and SCFAs: The applicable tension tests for fittings, including the strength/tension tests identified in Sections 3.4.2, and 3.5.1, shall be used to test and report on the permanent and elastic elongation/deformation under incremental loads of 20 percent, 40 percent, 60 percent and 80 percent, and 100 percent of the specified minimum (nominal) breaking strength of the cables.

5.0 QUALITY CONTROL

5.1 Each component and the factory-fabricated assembly of the SCFAs shall be manufactured under an approved quality control program with inspections by ICC-ES or by a properly accredited inspection agency that has a contractual relationship with ICC-ES; with the exception that field fabrication such as field-cutting and crimping swaging shall be subject to special inspection as required by Sections 1704 and 1705 of the IBC for field-fabricated components of all types of seismic bracing.

5.2 Quality documentation complying with ICC-ES Acceptance Criteria for Quality Documentation (AC10) shall be submitted for each manufacturing facility. The quality documentation shall include procedures for ensuring performance characteristics of the critical features of SCFAs, such as the tolerance for physical, chemical and mechanical properties, acceptance test standards, fabrication geometrical tolerance, tools and gauges for shop and field installations, shop and field installation instructions, and other aspects of the controls on the production.

5.3 A qualifying inspection shall be conducted at each manufacturing facility in accordance with the requirements
of the ICC-ES Acceptance Criteria for Inspections and Inspection Agencies (AC304).

6.0 EVALUATION REPORT RECOGNITION

The following information shall be included in the evaluation report:

6.1 Information described in Sections 2.1 and 4.2.

6.2 Structural Requirements for SCFAs that resist earthquake-induced forces, if applicable, must be provided by compression members that resist vertical (upward) movement, and that are designed in accordance with applicable code and standards.

6.3 Seismic Design Criteria:

6.3.1 General Criteria: The seismic design of CSSBAs must comply with Sections 13.1 and 13.2 of ASCE/SEI 7, with the exception of Section 13.2.2, which is not within the scope of this criteria.

6.3.2 Seismic Design Force: The structural design must comply with Section 13.3.1 of ASCE/SEI 7 for seismic design force requirements, including both horizontal and vertical (upward and downward) seismic force components.

6.3.3 Seismic Relative Displacement: The structural design must comply with Section 13.3.2 of ASCE/SEI 7 for seismic relative displacement requirements, as applicable.

6.3.4 Design Strength of a CSSBA: The design strength of a CSSBA must be the least of the following: (1) the design strength of the steel cable and fitting assembly (SCFA), determined according to Section 4.1; (2) the design strength of its end attachments and the design strength of the supporting structure, which are project-specific and shall be designed by a registered design professional; or, when applicable, (3) the end loops or wrapping, determined in accordance with Section 3.5.

6.3.5 Requirements for Attachments: The attachments, described in Section 1.4.1, must comply with Section 13.4 of ASCE/SEI 7 and Section 6.3.4 of this criteria. Consideration must be given to prying effects resulting from fitting geometry.

6.3.6 Requirements for Nonstructural Components: The architectural components must comply with Section 13.5 of ASCE/SEI 7. The mechanical and electrical components must comply with Section 13.6 of ASCE/SEI 7.

6.3.7 Resistance to Vertical Earthquake-induced Forces: The resistance to net upward vertical earthquake-induced forces, if applicable, must be provided by compression members that resist vertical (upward) movement, and that are designed in accordance with applicable code and standards.

6.4 The evaluation report must include a statement requiring special inspections as noted in Sections 1704 and 1705 of the IBC, for field fabrication such as field-cutting and crimping of all SCFAs.

6.5 There must be a statement that the SCFAs are limited to resisting seismic forces and controlling seismic force–induced sway (displacements) of nonstructural components only. The registered design professional may need to consider other load requirements as set forth in the applicable codes.

6.6 There must be a statement that when used as tension-only sway bracing for fire protection automatic sprinkler system installed in accordance with IBC Section 903 and NFPA 13, as referenced in Sections 13.6.5.1 (13.6.4.1 under the 2018 IBC), and 13.6.8.2 (13.6.7.2 under the 2018 IBC) of the ASCE/SEI 7, the SCFAs must comply with the requirements set forth in Section 9.3 of NFPA 13.

6.7 There must be a statement that the following items are beyond the scope of the evaluation report: (1) attachments described in Section 1.4.1, with the exception of end loops or wrapping of the SCFAs which are required to be qualifed according to this criteria; (2) the effects of elevated temperatures on the performance of SCFAs; (3) the effects of fatigue on the performance of SCFAs; (4) use with vibrating equipment unless dynamic loading on calculated stresses, fatigue, and deflections of the SCFAs are considered by the registered design professional for the specific applications; (5) protection against sharp resonant motions of nonstructural components, or shock loading; (6) outdoor applications and necessary corrosion protections; (7) special certification requirements for Designated Seismic Systems required by Sections 13.2.2, 13.2.5 and 13.2.6 of ASCE/SEI 7; (8) use as rigid seismic sway bracings resisting tension and compression forces; (9) replaceability requirement prescribed in Section 3.1.2 of ASCE/SEI 19-10; (10) post-construction considerations and inspection requirements prescribed in Section 9.0 of ASCE/SEI 19-10; and (11) pipe clamps, grooved couplings, or other similar hanger devices that are installed for the purpose of attaching SCFAs to sprinkler pipes.

6.8 Installation instructions shall state that the dead load of the nonstructural components shall be supported independently of the SCFAs, and that the SCFAs shall only be hand-tightened sufficiently to remove slack.

6.9 For SCFAs that have been cyclic tested per Section 3.5.2, the evaluation report shall include the maximum load and deformation limit determined from tests conducted in accordance with Sections 3.5.2.4 and 3.5.2.5, respectively.
**TABLE 1—APPLICABLE EDITIONS OF STANDARDS IN THIS ACCEPTANCE CRITERIA ASSOCIATED WITH THE CODES**

<table>
<thead>
<tr>
<th>ASSOCIATED STANDARD</th>
<th>2018 IBC</th>
<th>2015 IBC</th>
<th>2012 IBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCE 7</td>
<td>-16</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>ASCE 19(^1)</td>
<td>-16(^1)</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>ASTM A510</td>
<td>-13</td>
<td>-11</td>
<td>-08</td>
</tr>
<tr>
<td>ASTM A803</td>
<td>-98</td>
<td>-98</td>
<td>-98</td>
</tr>
<tr>
<td>ASTM A931</td>
<td>-14</td>
<td>-08</td>
<td>-08</td>
</tr>
<tr>
<td>ASTM A1007</td>
<td>-15</td>
<td>-07</td>
<td>-07</td>
</tr>
<tr>
<td>ASTM A1023</td>
<td>-15</td>
<td>-09</td>
<td>-09</td>
</tr>
<tr>
<td>ASTM E8</td>
<td>-16(^a)</td>
<td>-09</td>
<td>-09</td>
</tr>
<tr>
<td>NFPA 13</td>
<td>-16</td>
<td>-13</td>
<td>-10</td>
</tr>
</tbody>
</table>

\(^a\)Appendix E of ASCE 19-16 is not referenced in Chapter 13 of ASCE 7 for nonstructural components.